種子與種苗

—台灣遺傳資源之引種、保存、紀錄及利用—

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總摘要

遺傳資源之引進及貯藏的重要性為衆人所週知。種子貯藏的主要目的有三，即(1)長期保存種質（Germ-plasm）以避免發生遺傳損毀（Genetic erosion），(2)種質之分類與評估，(3)資料之整理及紀錄。

我國國際種子、種苗交換中心，於民國四十九年在台灣省農業試驗所成立，其目的為(1)與全省各機關如亞洲蔬菜研究發展中心、農業試驗所、各區農業改良場及其他機構等之種源庫合作，辦理種子之收集及交換工作。(2)與國外機構保持聯繫並交換種子及資料。(3)繼續保存所收集的遺傳資源及資料之分析及紀錄。

1.種子、種苗之檢疫

引進種子時為避免帶進病蟲害造成災害；我國有進口種子種苗檢疫之規定即(1)禁止輸入部份：主要病害為害嚴重地區之某類作物完全禁止引進。(2)限制輸入部份：種子之引進除須附輸入國之檢疫證明書外，必要時須先作燻蒸處理或引種後隔離栽培觀察。

檢疫方法有(1)隔離栽培觀察，(2)檢疫植物之接種檢查如汁液接種、嫁接等，(3)電子顯微檢查，(4)血清診斷。出口種子配合輸入國之檢疫規定與需求辦理，只要符合輸入國檢疫條件者即可放行。

2.民國50年到68年遺傳資源之引進及輸出數

自民國 50 年起，國際種子交換中心即負責本省之種子之引種及交換計劃。過去 19 年內，總計引進432種之作物，包括水稻、雜糧作物、特用作物、藥用作物、牧草及園藝作物等，共引進 11,507 個品種，其中雜糧作物引進4,469品種，佔總進口數之 38.5 %最多，其次為水稻佔 13.7 %，特用作物佔27.7 %，蔬菜佔 4.8 %，其他作物佔2.2 %。

過去 19 年間，由於外國之索取及我國農技團之需要，出口作物種類1,264種，總品種數達21,213 種品，佔進出口總量之64.8 %。其中蔬菜最多佔全出口品種之36.8 %，水稻次之佔30.1 %，再次為雜糧作物佔23.3 %，特用作物佔4.7 %。

引進之品種數量及交換國家，因不同年度而差異極大。

3. 遺傳資源之蒐集方法

本省種源的蒐集方法有(1)經由國際種子交換中心或本機關直接引進。(2)省內各研究機關間種源之交換或轉贈。(3)到國外旅行携回。其中65.2％計31,083品種之種源為直接從國外引進，國內各機關之轉贈及交換之種源佔23.6％計11,225品種。

4. 遺傳資源之保存機關

本省大部分從事農業研究改良之機關均有保存相當數量之種源。包括亞洲蔬菜研究發展中心，農業試驗所及二個分所，中興大學及7個農業改良場等20個農業研究機關為主要之遺傳資源保存機關。糖業研究所、林業試驗所、香蕉研究所亦皆保存其種源。

本省有13個機關（佔全部之65％）保存水稻種質。7個機關保存蔬菜及果樹種質。6個機關保存大豆種源。各有1機關保存纖維作物、茶樹及菸草之種質。

5. 遺傳資源保存之品種成品系數量

20個研究機關總計保存了47,651品種之遺傳資源。亞洲蔬菜研究發展中心有大豆9,945品種、綠豆4,986品種、蕃茄4,342品種、蔬菜706品種及甘藷422品種，農業試驗所保存13,309品種，佔總數之27.9％，即水稻（3,984種）、大豆（3,015種）、纖維作物（2,522種）、馬鈴薯（930種）、花生（910種）及蔬菜（730種）。

農業試驗所仍保存在民間已難於見到的老在來稻品種466品種及67種山地稻品種。半矮性在來稻低脚烏尖被利用為改良選拔出第一種秈型水稻品種"台中在來1號"之親本，更被利用為與菲律賓綠色革命有關之IR－8品種之育成。在來山地稻種目前在原產地亦很難找到，但農業試驗所仍有保存並供為抗旱性基因之來源，可見種質保存之重要性。

6. 遺傳資源之用途

種質保存之目的依不同作物及研究計劃而異。本省有8.8％之種質作為育種材料，84.2％為品種保存而保存，4.3％作為遺傳研究之材料，4.7作為生理研究及其他研究之材料。

7. 遺傳資源的保存方法

作物種子保存期間之長短，因作物種類、田間設施及貯藏設備之情形而異。一般作物用種子來保存，但甘藷、馬鈴薯等則用無性繁殖法來保存，部分藥用作物、茶樹、瓊麻及其他多年生作物則需長期在田間生長之狀態下保存。

作物種子一般在冷藏庫作短期（1年）、中期（3年）或長期（5－10年）之貯存。本省多數以每年繁殖一次，同時部份種子作長期貯藏的方法保存種子；佔總數之46.8％（20,667品種）。

8.保存種子之遺傳純度

自花授粉作物品種之遺傳純度較容易管理。但異花授粉作物之品種或野生種爲遺傳雜異性，本身含有不同之基因。本省保存品種中有58.7％之品種其遺傳純度不明。如玉米、高粱及向日葵利用自交系育成雜交種者，其親本來源之遺傳純度須特別小心保持。

9.種子貯藏方法及貯藏種子之發芽力

(1)種子貯藏之方法：種子貯藏設備有冷藏庫、電冰箱、玻璃乾燥器、鐵箱及塑膠袋等。本省有74.1％（25,955品種）保存在5°C及12.4％（4,346種）保存在10°C之冷藏庫內。貯存在冰箱中者少於10％，6.4％之種子在室溫下存放在乾燥器或鐵箱中。

(2)貯藏種子之發芽率：種子之發芽率依貯藏的情況而定。實驗顯示水稻之乾燥種子先在常溫下貯藏（在乾燥器內）2－6年後再放入10°C的冷藏庫10年後，種子仍具良好生活力。例如實驗中之1號乾燥器內有2品種（20％）仍具85－95％的發芽率，其餘8品種（80％）則有5－65％的發芽率。但另一乾燥器（24號）內品種之發芽率則低於15％。

花生種子在室溫下通常在短期內（約6－8個月）即喪失其發芽力。在一項花生種子發芽力之實驗中發現在10～12°C之溫度下，帶殼的花生種子貯存3年9個月仍保持84％的發芽率。但去殼的花生種子其發芽率在一年內即降低爲45％。因此花生種子最好在帶殼、低溫及濕度狀態下貯藏。

1982年林試所進行的一項試驗中表示，當台灣杉品種之種子，在超低溫－10°C至－20°C之溫度下貯藏，經3.5年的貯藏仍具60％的良好發芽能力。但在5°C溫度下貯藏則在2.5年即喪失種子生活力。而在室溫貯藏不超過9個月之種子即完全失去其生活力。因此林木種子之貯藏須在超低溫冷凍之情況下貯藏。

因台灣杉種子之生產具明顯之週期性（3－7年），在豐年時才能生產足量的種子供爲栽培之用，故此種短期繁殖性之品種需要長期之貯藏。原來具35.7％發芽率的林木種子經8年在－20°C低溫下冷凍保存後仍具有26.7％的發芽率即可證明。

10.種子之最少貯存量

種子之貯存量依保存目的及貯藏設備等而差異極大。一般而言，貯存種子量愈多則愈好，但限於設備容量及經費問題，實際上僅能保存最少之貯存量。本省一般貯存種子量以每品種保存50克者最多佔30.7％，計8,986品種。以每品種100g保存的種子佔15.7％，而有5.7％之種子是用每品種200g之貯存量來保存。

11.遺傳資源之紀錄

利用遺傳材料時種子資料之紀錄非常重要。本省過去都用傳統的紀錄卡歸成檔

案或將資料紀錄在種子目錄內。

自1978年起農試所開始使用電腦化作業之資料紀錄。目前使用的是ACS系統(Alphanumeric Coding System),但將改爲DCS System CDecimal Coding System),來配合其他機構之種源庫電腦化資料。電腦化作業所包含之資料如下:

(1)一般性資料

品種或品系數

蒐集資料(收集者,日期等)

名稱資料(學名及俗名)

來源(國家、州或省)

貯藏資料(貯藏之地點、日期等等)

分配資料

(2)作物性狀之紀錄

農藝性狀

遺傳性狀

生理性狀

生化性狀

環境條件(寒、旱、風之感受性等)

病蟲資料(眞菌、病毒、細菌、昆蟲、線蟲等)

種子之繁殖(種子之發芽率;貯存時間)

(3)用途資料

包含遺傳、育種、測驗用等資料

茲以水稻種子爲例說明之。每一品種之農藝性狀、遺傳性狀、生理性狀及化學性狀等27種資料皆紀錄在磁碟及磁帶上,各自成一主檔(Master file)及一個副檔(Transaction file)。紀錄媒體之資料則隨時可修改更新。

任何研究者需要具某些特性的種子時,可先塡妥請求表格送到資料中心,該中心即利用"種源庫資料取出程式"(GBIRP)輸入電腦,所需之種子名稱在極短的時間內即可打印出來,種源庫即可根據此電腦資料立刻提供所需種子。

12.作物種子之生產及利用

本省農作物種子、種苗之生產,已建立原原種—原種—採種之三級制,水稻種子之生產多年來已照此制度繁殖推廣。農林廳種苗繁殖場負責本省水稻以外之已登記的優良作物品種之繁殖,目前所生產之種子、種苗有旱作(高粱、玉米、綠肥作物)、蔬菜(蕃茄、蘿蔔、甘藍)、花卉(康乃馨、劍蘭等)及其他球根花卉等。本省目前之蔬菜種子的生產已進入企業化生產,農友種苗公司產銷西瓜、胡瓜、蕃茄、甜椒、青花菜、花椰菜、結球白菜、南瓜、苦瓜、越瓜、絲瓜、辣椒等之雜交F1種子甚爲成功。不僅對本省蔬菜生產有貢獻且外銷種子,每年賺取大量外匯。

總而言之,本研討會對本省過去之農作物、蔬菜及林木之種質做一次全面性的淸查,對各機關(包括國際機構亞洲蔬菜研究及發展中心)所保存種子之種類、品種數、貯藏設備、保存方法及紀錄情形以及過去十九年來國際種子交換中心之學術性種子、種苗之交換情形做一次總檢討以供將來成立全國性大規模之種子保存中心作參考。

Genetic Resource Collection, Preservation Documentation and Utilization in Taiwan

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General Summary

The necessity for the introduction and conservation of genetic resources has been widely recognized. The main purpose of a conservation program will be (1) maintenance of germplasms which are subjected to genetic erosion, (2) classification and evaluation of genetic stocks, (3) record-keeping and documentation.

The International Seed and Seedling Exchange Center was established in the Taiwan Agricultural Research Institute (TARI) in 1960. This center is (1) to collect and exchange genetic resources in cooperation with the existing germplasm banks of TARI, Asian Vegetable Research and Development Center (AVRDC), National Chung-Hsing University and other research organizations, (2) to communicate with foreign agricultural institutions on information pertaining to the plant materials exchanged, (3) to collect and keep on the genetic resources exchanged.

1. Quarantine and Inspection of Seeds

In order to prevenf from importing the harmful insect pests and diseases along with seeds, we have quarantine regulations to prohibit importing certain crops from the major diseased area. The regulation, however permits the import of limited seeds accompaning the quarantine certificate.

The imported seeds are further tested for their cleaness by the following methods, before

they can be utilized: (1) isolated field observation, (2) inoculation test with plant juice (of imported plant) or by grafting, (3) electron microscopic study and (4) immunological test.

2. The Number of Genetic Stocks Introduced and Sent-out During the Period 1961-1979.

Since 1961 the germplasm introduction and exchange project has been conducted by the International Seed and Seedling Exchange Center attached to Taiwan Agricultural Research Institute. In the past 19 years, 432 species of plants including rice, other food crops, industrial crops, medicinal plants, forage crops, horticultural crops, etc., with a total number of 11,507 strains, have been introduced. Soybean, peanut, corn, potato, etc., called "miscellaneous food crops" in Taiwan, occupy 38.5% (4,469 varieties) of total introduction, followed by rice (13.7%), industrial crops (27.7%), vegetables (4.8%) and other crops (2.2%).

In the past 19 years, a total of 21,213 strains which correspond to 64.8% of total introduction were sent out to foreign countries in response to their requests. Vegetables stood the first place (36.8%) of total exported, rice comes to next being 30.1%, "miscellaneous food crops" being 23.3% and industrial crops 4.7%. The number of varieties introduced or exchanged and the countries involved fluctuated greatly according to years.

3. Methods of Genetic Resources Collection

In Taiwan, the genetic stocks are collected (1) through the International Seed Exchange Center of TARI or directly by a research organization from foreign countries, (2) by transfer or exchange of genetic stocks among different organizations in Taiwan, (3) from the field by

traveling. 65.2% (31,083 varieties of genetic stocks were directly introduced from various countries of the world, and 23.6% (11,225 varieties) were transferred among organizations in Taiwan.

4. Organization Maintaining Genetic Resources

Most agricultural research organizations handling crop improvement maintain a certain amount of genetic stocks. Twenty research organizations in Taiwan, including Asian Vegetable Research and Development Center (AVRDC), Taiwan Agricultural Research Institute (TARI) and its two branch stations, National Chung-Hsing University and 7 District Agricultural Improvement Stations, etc. are major institutions maintaining genetic resources. Taiwan Sugar Research Institute, Taiwan Forestry Research Institute, Taiwan Banana Research Institute also maintain tneir genetic resources.

13 organizations (65% of total) maintain rice genetic stocks. Seven organizations maintain vegetables and fruit trees and six maintain soybean. Fiber crops, tea crop and tobacco are each maintained by one organization.

5. The Number of Varieties or Lines of Genetic Resources Being Maintained

The total numbers of genetic stocks maintained by the 20 organizations are 47,651. The AVRDC has soybean (9,945 varieties), mungbean (4,986 varieties). tomato (4,342 varieties), vegetables (706 varieties) and sweet potato (422 varieties).The TARI maintains 27.9% (13,309 varieties of total genetic stocks, including rice (3,984 varieties), soybean (3,015 varieties), fiber crops (2,522 varieties), potato (930 varieties), peanut (910 varieties) andnd vegetables (730 varieties)

466 native [illegible]rieties and 67

mountainous varieties of rice are maintained by the TARI. These old native rice varieties are rarely found in the farmers' fields today. The semi-dwarf native variety Ti-chueh-wu-chien (known as Dee-geo-woo-gen) was used to develop the first improved *indica* type variety "Taichung Native No.1". Ti-chueh-wu-chien was also used as a cross parent to develop IR-8 which was regarded as the green revolution in the Philippines.

The native mountainous varieties which were mainly cultured by the aboriginal tribes of Taiwan are also rarely seen in the original places, but they are maintained by TARI as the source of genes for drought resistance.

6. Purposes of Maintaining Genetic Resources

The objectives of germplasm maintenance differ according to genetic stocks and institutions. In Taiwan, 8.8% are for breeding material, 84.2% are for preservation itself, 4.3% are for genetic studies, and 4.7% are for physiological and other studies.

7. Methods of Maintaining Genetic Resources

The duration of seed storage differs according to crop species, field condition and storage facility. The majority of germplasms are propagated by seeds, but crops like potato, sweet potato, etc. are propagated vegetatively. Some medicinal plants, tea, sisal and other perennial crops are maintained in the field.

Crop seeds are stored in cold storage room for short-term (1 year), mid-term (3 years), or long-term (5-10 years). The most popular way of seed maintenance is long term storage plus yearly propagation, which occupy 46.8% (20,667 varieties) of the total genetic stocks.

8. Genetic Homogeneity of Germplasms Maintained

Varieties of self-pollinated crops can be managed as genetically pure lines. But, varieties of cross-pollinated crops as well as of wild species are genetically heterogenous and contain different genes within themselves. A majority of genetic stocks now under preservation (58.7%) are not described as to their homogeneity. More careful observations are needed in the future. Inbred lines for producing hybrids were developed in corn, sorghum and sunflower.

9. Method of Seed Storage and Viability of Stored Seeds

(1) *Methods of seed storage*

Seeds are stored in cold storage rooms, or refrigerators with glass desicators, iron boxes or plastic bags. 74.1% (25,955 varieties) of stock seeds are kept at 5°C and 12.4%(4,346 varieties) at 10°C in cold storage rooms. Less than 1% are stored in refrigerators, 6.4% are in desicatores or iron boxes under room temperatures.

(2) *Viability of stored seeds* :

Viability of seeds depends on the condition of storage. Germinability is tested frequently during the storage. When dried rice seeds put in desicators were kept at room temperatures for the first 2-6 years and at 10°C for 10 years, the seeds showed a good viability. For instance, the seeds of 2 varieties stored in desicator No. 1 had a germinability of 85-95%, 2 varieties (or 20%) still have 85-95% of germination rate and the remaining 8 varieties or 80% had the germination rates of 5-65%. However, the seeds in another desicator (No. 24) showed a germinability less than 15%.

The viability of peanut seeds usually deteriorates in a very short period (6-8 months) when stored at room temperatures. An experiment was conducted to evaluate the viability of peanut seeds stored at 10-12°C: It was found that when

peanut seeds with pods were stored for 3 years and 9 months they still maintain 84% of germinability. But when the seeds were separated from pods, the germinability reduced yearly and remained only 45% of germinability after the same duration of storage. Therefore, it is desirable that peanut seeds should be stored in the form of pods under the low temperature and low humidity conditions.

In another experiment conducted by Hu and Chung (1982), when the seeds of *Taiwania cryptomerioides* (an important timber species) were stored at -10°C to -20°C, a good germinability (60%) was observed after 3.5 years of storage. When seeds were stored at 5°C, the viability was lost in 2.5 years. When the seeds were stored at room temperatures, the viability did not last over 9 months of storage. To keep the seeds of forest trees, a subfreezing low temperature is necessary.

Since *Taiwaia Cryptomerioides* has a long natural periodicity (3-7 years) of seed production and only good crop years can produce enough quantity of seeds for planting, a long-term storage for the seeds of this short-lived species is necessary. After 8 years of storage at the subfreezing temperature of -20°C, the seeds still retain 26.7% of viability. The original germination rate was 35.7%.

10. The Minimum Quantity of Seeds Stored

The amount of seeds stored differ greatly according to the objectives of maintenance, storage facility, etc. In general, the more seeds are stored, the more desirable. However, due to the limitation of space and running expenses, in practice, the minimum quantity of seeds are preserved. The most popular quantity of seed per variety stored is 50 g for 30.7% of germplasms (8,986 varieties)

maintained. 15.7 % of genetic stocks were maintained with 100 g of seeds, and 5.7% with 200 g of seeds.

11. Recording and Processing System of Genetic Resources

A system for recording and processing data on germplasms is essential in utilizing the genetic stocks. In the past years we used the conventional method of recording system by keeping file of the record cards or keeping the informations in the seed catalogues.

Since 1978, the computerized data management system for germplasm bank has been adapted by TARI. An ACS system (Alphanumeric Coding System) is now being used, however, we are planning to change it into a DCS system (Decimal Coding System) for the convenience of comparison of the printed out data with those of other organizations in the near future. The following informations are included:

(1) General information,

Variety or accession number

Collection information (collector, date, etc.)

Nomenclature information (scientific and common)

Origin (country, state or province)

Storage information (location, date of storage, etc.)

Distribution information

(2) Organismic information

Morpho-agronomic

Genetic

Physiological

Biochemical

Environmental (cold, drought, wind susceptibility, etc.)

Pest and disease information (bacterial, fungal, viral, insect, nematode, etc.)

Rejuvenation (viability of seeds, time of storage)

(3) Use information

Including breeding, genetics, performance tests, etc.

The operation system is illustrated in the following.

Taking rice germplasms as an example, 27 informations, including agronomic, genetic, physiological and chemical characters for each individual variety are recorded on both tape and disc which serve as Master fild and Transaction file respectively. The records on the files can be corrected or renewed immediately as it is needed.

Any scientist who needs the genetic stocks possesing the specified informations should first fill-in the request form and submitted to the documentation center. The request will be processed by using the germplasm bank information retrieval program (GBIRP) and the result will be printed out in a short period of time.

12. Seed Production and Supply

In Taiwan, a system of three-step seed multiplication (breeder's seeds, foundation seeds and extension seeds) is practiced. Rice seeds are produced through this system by the Agricultural Improvement Stations and the Farmer's Associations. The government operated Taiwan Seed Service is responsible to produce seeds of upland crops (sorghum, corn, green manure crops), vegetables (tomato, radish and cabbage), ornamental flowers (carnation and gladiolus) and other tuberous flowers. The F_1 hybrid seeds of vegetables are produced mainly by Known-You Seed Company in large scale for domestic use as well as for exporting. They include watermelon, cucumber, tomato, sweet pepper, hot pepper, broccoli, cauliflower, Chinese cabbage, pumpkin, bitter melon and melon, etc.

In summary, this symposium is concerned with the present status of germ-plasm collection, preservation, documentation and utilization of various crops in Taiwan such as rice, upland crops (soybean, peanut, corn, sor-

ghum, etc.) special crops, fiber crops, medicinal crops, vegetables and forest trees. The number of crops, number of varieties preserved, seed storage facilities, seed germinability during the storage period in various research institutions in Taiwan were discussed. The present status of commercial seed production of rice, and vegetables by the government agencies and private seed company was also discussed. It was strongly recommended by the symposium that a national germ-plasm bank with modern facilities should be established to strengthen the work of preserving genetic resources.